CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) required the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) Program into a single office within the Office of the Secretary of Defense. The public law also directed the Secretary of Defense designate the Army as the Executive Agent for coordination and integration of the CBD Program. The executive agent for the Small Business Innovation Research (SBIR) portion of the program is the Army Research Office-Washington (ARO-W).

The objective of the DoD CBD Program is to enable U.S. forces to survive, fight and win in chemical and biological warfare environments. Numerous rapidly-changing factors continually influence the program and its management. These forces include declining DoD resources, planning for warfighting support to numerous regional threat contingencies, the evolving geopolitical environment resulting from the breakup of the Soviet Union, U.S. participation in the Chemical Weapons Convention, and the continuing global proliferation of chemical and biological weapons. Improved defensive capabilities are essential in order to minimize the impact of such weapons. U.S. forces require aggressive, realistic training and the finest equipment available that allows them to avoid contamination, if possible, and to protect, decontaminate and sustain operations throughout the non-linear battlespace. Further information about the DoD CBD Program (and related programs) is available at the DoD Counterproliferation and Chemical Biological Defense Homepage at Internet address http://www.acq.osd.mil/cp/.

The overall objective of the CBD SBIR Program is to improve the transition or transfer of innovative CBD technologies between DoD components and the private sector for mutual benefit. The CBD SBIR Program includes those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection; information assessment, which includes identification, modeling and intelligence; contamination avoidance; and protection of both individual warfighters and equipment.

Tri-Service Program

The U.S. Army, Navy, Air Force, and SOCOM have developed separate SBIR topics for research and development in various CBD areas of interest. As lead agency, the Army will coordinate efforts related to the receipt, evaluation, selection, and award of Phase I proposals and similarly for potential follow-on Phase II efforts under this program.

Submitting Your Phase I CBD SBIR Proposal

The CBD SBIR Program now requires that a proposing firm have Internet access via the World Wide Web, in order to submit its Phase I CBD SBIR proposal – in its entirety – online. You must also submit an original and two copies via mail or other delivery means (See 3. Postal Submission below). Please review and follow these procedures when submitting each Phase I proposal:

1. Online Submission: The entire proposal including all forms must be submitted via the Internet. Go to the DoD SBIR proposal submission site (URL address: http://www.dodsbir.net/submission/) which will lead you through the preparation of the following proposal sections:

a. Proposal Cover Sheet Pages (Firm information and project abstract)
b. Cost Proposal (Must use online form provided)
c. Technical Proposal (File upload via submission site)
d. Company Commercialization Report (Does not count against 25 page limit)

2. Acceptable Formats for Technical Proposal Upload: All technical proposal files will be converted to Portable Document Format (PDF) for evaluation purposes. Acceptable formats (PC/Windows) are: MS Word, WordPerfect, PDF, Text, and Rich Text Format (RTF). The Technical Proposal should include all graphics and attachments, conform to the limitations on margins and number of pages, and exactly reflect the hardcopy version. Offerors are responsible for performing a virus check on each submitted Technical Proposal. Each submitted electronic technical proposal will be scanned for viruses. The detection of a virus on any submitted electronic Technical Proposal may cause rejection of the proposal.

3. Postal Submission: Postal submission includes an original signed proposal with all forms and required attachments, plus two copies. All proposals written in response to topics in this solicitation must be received by the date and time indicated in Section 6.2 of the introduction to this solicitation. Offerors are advised to submit proposal(s) well before the deadline. **Late proposals will not be accepted.**

All Phase I proposals - one original (clearly marked, with original signatures) and two copies - must be submitted to the CBD SBIR Program Management Office at the address below. Each copy must include the Technical Proposal, signed Proposal Cover Pages, signed Cost Proposal and the signed Company Commercialization Report. All hand deliveries must be made to the Army Materiel Command (AMC) building mail room, located at the rear of the AMC building. Proposers should be aware that the AMC mailroom hours are 0730-1530 hrs (local) and are subject to change without prior notice. *Offerors using non-government courier services assume the risk for late delivery of proposals.

Mail proposals to:
Major Janice Baker
U.S. Army Research Office-Washington
Room 8N31, Army Materiel Command Building
5001 Eisenhower Avenue
Alexandria, VA 22333-0001
(703) 617-8260

Please Note: Potential offerors must follow the proposal content rules for the agency which has proponency for topics. Topics are numbered in series, with Army topics starting at 100, Navy topics starting at 200, Air Force topics starting at 300, and SOCOM topics starting at 400. Detailed instructions for proposals to be submitted against Army topics are given below. Refer to the appropriate Navy, Air Force, and SOCOM sections in this Solicitation for information on how to prepare proposals for submission against Navy, Air Force, and SOCOM CBD SBIR topics.

Army Proposal Guidelines

The Army has enhanced its Phase I-Phase II transition process by implementing the use of a Phase I Option that the Army may exercise to fund interim Phase II activities while a Phase II contract is being negotiated. The maximum dollar amount for a Phase I feasibility study is $70,000. The Phase I Option, which **must** be proposed as part of the Phase I proposal, covers activities over a period of up to four months and at a cost not to exceed $50,000. All proposed Phase I Options must be fully costed and should describe appropriate initial Phase II activities which would lead, in the event of a Phase II award, to the successful demonstration of a product or technology. **The Army will not accept Phase I proposals which exceed $70,000 for the Phase I effort and $50,000 for the Phase I Option effort**. Only those Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to exercise the Phase I Option. To maintain the total cost for SBIR Phase I and Phase II activities at a limit of $850,000, the total funding amount available for Phase II activities under a resulting Phase II contract will be $730,000.

Companies submitting a Phase I proposal to the Army under this Solicitation must complete the Cost Proposal within a total cost of $70,000 (plus up to $50,000 for the Phase I Option). Phase I and Phase I Option costs must be shown separately; however, they may be presented side-by-side on a single Cost Proposal. The Phase I Option proposal must be included within the 25-page limit for the Phase I proposal. In addition, all offerors will prepare a Company Commercialization Report, for each proposal submitted, which does not count toward the 25-page limitation.

Selection of Phase I proposals will be based upon scientific and technical merit, according to the evaluation procedures and criteria discussed in this solicitation document. Due to limited funding, the Army reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded.

Proposals not conforming to the terms of this solicitation, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

Army Phase II Proposal Guidelines

CBD SBIR Phase II proposals are invited by the individual Service or SOCOM from CBD SBIR Phase I projects that have demonstrated the potential for commercialization of useful products and services. The invitation will be issued by the Service organization or SOCOM personnel responsible for the Phase I effort. Invited proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing the developed technology. Fast Track participants may submit a proposal without being invited. Cost-sharing arrangements in support of Phase II projects and any future

commercialization efforts are strongly encouraged, as are matching funds from independent third-party investors, per the SBIR Fast Track Program (see section 4.5). Commercialization plans, cost-sharing provisions, and matching funds from investors will be considered in the evaluation and selection process, and Fast Track proposals will be evaluated under the Fast Track standard discussed in section 4.3. Phase II proposers are required to submit a budget for a base year (first 12 months) and an option year. These costs must be submitted using a Cost Proposal, and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on the Proposal Cover Page, Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year.

The Army is committed to minimizing the funding gap between Phase I and Phase II activities. With the implementation of Phase I Options, all Army Phase II proposals will receive expedited reviews and be eligible for interim funding. Accordingly, all Army Phase II proposals, including Fast Track submissions, will be evaluated within a single evaluation schedule.

Key Dates

02.1 Solicitation Open	1 December 2001 – 16 January 2002
Phase I Evaluations	**January - March 2002**
Phase I Selections	March 2002
Phase I Awards	May 2002
Fast Track Applications Due	September 2002
Phase II Invitations	September 2002
Phase II Proposals Due	October 2002

PROPOSAL CHECKLIST

This is a Checklist of Requirements for your proposal. Please review the checklist carefully to assure that your proposal meets the Army CBD SBIR requirements. **Failure to meet these requirements will result in your proposal not being considered for review or award**. Do not include this checklist with your proposal.

_____1. The proposal cost adheres to the individual Service (Army, Navy, Air Force) or SOCOM criteria specified.

_____ 2. The proposal is limited to only **ONE** solicitation topic. All required documentation within the proposal references the same topic number.

_____ 3. The proposal, including the Proposal Cover Sheets and Cost Proposal, is 25 pages or less in length. (Excluding the Company Commercialization Report.) Proposals in excess of this length will not be considered for review or award.

_____4. The entire proposal including all forms must be submitted via the Internet using the DoD's SBIR Proposal Submission System which can be accessed at URL address: http://www.dodsbir.net/submission/.

_____ 5. The Proposal Cover Sheet and the Project Summary Sheet, are the first two pages of your proposal. The Proposal Cover Pages clearly show the proposal number assigned by the system to your proposal and is signed. The Project Abstract contains no proprietary information, does not exceed 200 words, and is limited to the space provided. The Cost Proposal is complete, signed, and is included as the last section of the proposal. (For Army topics the **Phase I and Phase I Option** costs must be shown separately on the Cost Proposal).

_____ 6. The Company Commercialization Report, is submitted in accordance with Section 3.4.n. This report will be signed and is required even if the company has not received any SBIR funding. (This report does not count towards the 25-page limit)

_____7. The proposal contains only pages of 8-1/2" X 11" size. No other attachments such as disks, and videotapes are included. The proposal contains no type smaller than 11-point font size (except as legend on reduced drawings, but not tables). The proposal is stapled in the upper-left-hand corner and no special binding or covers are used.

_____8. An original with original signatures as required **(clearly marked)** and two copies of the proposal are submitted. The proposal must be sent registered or certified mail, postmarked by January 9, 2002, or delivered to the Army SBIR Program Management Office no later than **January 16, 2002, 3:00 p.m. local time** as required (see Section 6.2). Offerors who elect to use commercial courier services do so at their own risk. The Army **cannot** accept responsibility for proposals delivered late by commercial couriers.

_____9. Include a self-addressed, stamped envelope and a copy of the Notification Form (Reference A) located in the back of the solicitation book, if notification of proposal receipt is desired. **No responses will be provided if these are not included with your proposal**.

INDEX OF CHEMICAL AND BIOLOGICAL DEFENSE 02.1 TOPICS

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CHEMICAL AND BIOLOGICAL DEFENSE 02.1 TOPIC DESCRIPTIONS

ARMY CBD SBIR TOPICS

CBD02-100 TITLE: Molecular Signatures of Biological Pathogens

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: To identify and characterize genetic responses to pathogen exposure at a genome level. To identify early molecular markers of biological agent exposure. To develop a database of human responses to various pathogens so that exposure can be determined and the agent can be accurately identified within minutes or hours of contact. To enable extremely rapid and accurate identification of human exposure to infectious pathogens and biological warfare agents, so that appropriate countermeasures can be administered, and the effects of the biological agent can be decimated or neutralized.

DESCRIPTION: Exposure of humans to pathogens has been demonstrated to be detectable within hours of contact by measuring gene expression levels on a genomic scale (i.e. using microarray chips). While this technology has been shown to be capable of much earlier detection of exposure than traditional methods, at present the human genomics databases are insufficient to diagnose which pathogen a person was exposed to. Research is needed to develop a database of the human genomic response to various pathogens. Development of such a database will allow medical personnel to use very small amounts (less than a drop) of bodily fluids (urine, blood, sputum, sweat, or nasal swabs) to detect and diagnose exposure to an infectious agent. Such early detection of pathogen exposure would allow medical personnel to administer countermeasures before the pathogen has reached levels high enough to cause an effect. Eventually, this technology could be used in extremely small units that would take tiny samples painlessly and automatically, and continually monitor warfighter exposure to biological warfare and infectious disease agents. The threat of biological warfare agents would thus be almost eliminated, and sick time due to transmission of infectious diseases would be greatly reduced.

PHASE I: The investigators will identify a group of individuals from whom they can take very small fluid samples frequently (such as twice a day). This group should be relatively young, healthy, and reflect the genetic diversity of the U.S. Armed Forces. The investigators will take fluid samples from the entire group at regular intervals and store the samples. The investigators will choose one class of infectious pathogen to which exposure is readily available (such as rhinoviruses). When the volunteers develop the infection, the pathogen will be isolated and its identity determined. Fluid samples from that volunteer will be assayed using microarray chips. Enough pre-exposure samples will be examined to establish the individual variability in gene expression. Samples from the individual who developed the infection will also be examined from the time of exposure to the time of maximum illness. The successful phase I project will identify the genetic responses of human exposure to the particular pathogen examined. The noise generated by daily variation within individuals and individual to individual variation will be known. The investigators will identify which genes alter gene expression levels in response to this class of pathogens, and the genetic responses will be classified by the number of hours after exposure that they occur. A rigorous statistical framework will be in place so that the accuracy of the diagnosis is known.

PHASE II: The investigators will expand their research to investigate multiple types of pathogens, including bacterial, viral, and fungal. The investigators will generate a database of human responses to the various types of pathogens, and demonstrate that this database can be used to identify pathogen exposure within hours of the exposure. In addition, the investigators will demonstrate that the pathogen or class of pathogen can be identified by the pattern of genes that alter their expression levels. Pathogen diagnosis by genomic profiling will be confirmed by standard laboratory procedures to culture and identify microorganisms. Accuracy of the identified patterns of gene expression will be confirmed by assaying blind samples. The investigators will build a prototype for a selected pathogen, which could be used as the basis for a phase III commercial product.

PHASE III DUAL USE APPLICATIONS: It is anticipated that this database will lead to a microarray chip that will have broad applications in medical diagnosis of infectious diseases. The second generation of such chips could be targeted to identifying the molecular signals preceding medical conditions such as stroke, and other medical conditions not caused by infectious diseases.

REFERENCES:

1. Blader IJ, Manger ID, Boothroyd JC. Microarray analysis reveals previously unknown changes in toxoplasma gondii infected human cells. J Biol Chem. 2001 Apr 9 (epub).
2. Kurella M, Hsiao LL, Yoshida T, Randall JD, Chow G, Sarang SS, Jensen RV, Gullans SR. DNA microarray analysis of complex biologic processes. J Am Soc Nephrol. 2001 May;12(5):1072-8.
3. Maeda S, Otsuka M, Hirata Y, Mitsuno Y, Yoshida H, Shiratori Y, Masuho Y, Muramatsu Ma, Seki N, Omata M. cDNA Microarray Analysis of Helicobacter pylori-Mediated Alteration of Gene Expression in Gastric Cancer Cells. Biochem Biophys Res Commun. 2001 Jun 8;284(2):443-9.
4. Manger ID, Relman DA. How the host 'sees' pathogens: global gene expression responses to infection.

5. Curr Opin Immunol. 2000 Apr;12(2):215-8.

KEYWORDS: Microarrays, Genomics, Chips, Pathogens

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CBD02-101 TITLE: Automated Preferential Display of Genes of Unknown Sequences

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: Develop an integrated, automated, miniature method of detecting unique gnees and their level of expression without a prior knowledge of gene sequences.

DESCRIPTION: A variety of methods and technologies are available for detection of unique genes from a complex pool of gene sequences. However, almost all of these methods possess two major problems. These methods do not selectively display unique sequences. All gene sequences are amplified and presented (with the exception of subtractive hybridization-based methods). It is estimated that redundant sequences account for approximately 94% of all genes expressed using current display technologies [1]. Thus, large numbers of genes are displayed resulting in expenditure of much time and resources in identification of redundant sequences. Secondly, these methods are tedious and expensive involving use of sophisticated instrumentation and conventional gel electrophoretic methods. There is a need for development of a platform technology capable of selective detection of unique genes from a complex pool of genes without requiring the use of conventional electrophoretic methods, perhaps fluorescence-based and easily amenable to automation and miniaturization. Sequencing of the approximately 30,000 genes in the human genome, and the sequencing of complete pathogen genomes, combined with microarray technology and the power of bioinformatics, have resulted in the development of gene arrays (a.k.a. gene chips) with a variety of important applications. Such arrays measure the relative expression of thousands of genes and have tremendous promise for detection and identification of biological agents, including genetically modified organisms. The single greatest rate-limiting factor in fully exploiting these technologies is the current inability to consistently immobilize the biological materials on glass and silicon substrates, a problem which will be complicated by next generation chip materials such as titanium alloys. Such a technology will not only allow rapid detection of 'stealth' pathogens and/or genetically engineered pathogens without requiring prior knowledge of the gene sequences but also aid in determining the effects of low dose exposure to toxic agents at the gene level.

PHASE I: Develop and validate a method/protocol for 'selective' screening and detection of unique genes without requiring prior knowledge of the gene sequences. The method should be relatively simple, requiring minimal skilled user intervention, amenable to single tube reaction mixture and/or miniaturization and ideally suited for use with high throughput gene expression analytical applications. Identify current and future chip materials, the immobilization processes commonly used genes, oligonucleotides and proteins, and the quality of current array manufacturing processes.

PHASE II: Present day differential gene expression analysis methods such as Differential Display [2], Subtractive Hybridization [3], RNA-arbitrary primed PCR (RAP-PCR) [4], Representative Difference Analysis (RDA) [5], Serial Analysis of Gene Expression (SAGE) [6,7,8] screen for unknown differentially expressed genes. However, they are not amenable to miniaturization and when carried out at the bench require sophisticated and expensive instrumentation. Most of these technologies require bench top elaborate mRNA isolation schemes, thermocyclers, hybridization chambers, electrophoresis and fluorescent scanner/imaging apparatus. Such applications are not only expensive but also impractical for high throughput purposes. Development of an integrated high throughput system for automated gene detection of unknown sequence is highly desirable and will require identification of manufacturing issues and proposed solutions to address accuracy, precision, reliability and cost. Microarray techniques are powerful approaches, however, their usage is often limited largely by the challenge of data management and analysis [9]. Such a technology can dramatically decrease the number of genes to be analyzed and data to be handled by selective expression of only expressed genes. Front-end integration of selection and presentation of preferentially expressed genes to microarrays developed by Affymetrix, Incyte, NEN, Clontech, etc. is also desirable.

Deliver reagents, final protocols and data validated with standard gene expression analysis methods along with identified unique gene sequences from the targets of interest. Protocols using fluorescence-based analysis are highly desirable. High throughput automation with miniaturization on a microchip level or single tube reaction is required in Phase II. Phase II deliverables should

also include any high throughput system developed, a microchip and/or any other consumables necessary for performing the assay. Development of a method that can measure the level of gene expression is also highly desirable.

PHASE III DUAL USE APPLICATIONS: Such a technology will provide for the pharmaceutical industry a very simple and accurate pharmacogenomic method to evaluate new drug effectiveness, isolation of novel sequences for diagnostic applications, discovery of disease and treatment motifs, and reduction of the expense of medical treatments and hospitalization. It will substantially lower the cost and time in the drug development cycle by affording a more accurate drug target validation, minimizing toxic effects in the drug discovery process and reducing time to market of these drugs. The technology will also have widespread application in assessing the effects of toxicants at the level of gene expression and would serve as a high throughput toxicology screen which would replace animals.

REFERENCES:
1. Artinger, M. et al. (1998) High throughput Analysis of Differential Gene Expression. J. Cell. Biochem. Suppl. 30/31, 286-296
2. Liang, P. and Pardee, P. B. (1997). Differential Display Methods and Protocols. Methods in Molecular Biology. Humana Press, New Jersey.
3. Swaroop, A. et al. (1991) A simple and efficient cDNA library subtraction procedure: Isolation of human retina-specific cDNA clones. Nucleic Acids Res. 25, 1954
4. Ito, T. et al. (1994) Fluorescent differential display: Arbitrarily primed RT-PCR fingerprinting on an automated DNA sequencer. FEBS Lett. 351, 231–236
5. Prashar, Y. and Weissman, S. (1996) Analysis of differential gene expression by display of 39 end restriction fragments of cDNAs. Proc. Natl. Acad. Sci. U. S. A. 93, 659–663
6. Polyak, K. et al. (1997) A model for p53-induced apoptosis. Nature 389, 300–305
7. Hillier, L. et al. (1996) Generation and analysis of 280,000 human expressed sequence tags. Genome Res. 6, 807–828
8. Lennon, G.G. et al. (1996) The I.M.A.G.E. consortium: An integrated molecular analysis of genomes and their expression. Genomics 33, 151–152
9. Bowtell, D.L. (1999) Options available – from start to finish – for obtaining expression data by microarray. Nat. Genet. (Suppl.) 21, 25–32

KEYWORDS: Gene Expression, Gene Sequencing, Pathogen Detection, Bioforensics, Toxicogenomics, Microarrays, Genomics

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CBD02-102 TITLE: Smokes Originating From Biological Materials

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: To design, test and develop military smokes that originate from biological systems. To take advantage of the natural ability of biological systems to produce biodegradable or environmentally innocuous particles via molecular assembly or self-assembly into tailorable monodisperse distributions.

DESCRIPTION: The US Army has a continuing need for improved materials for smoke and obscuration. The core figure of merit for smoke materials is the extinction coefficient in the radiation band of interest and central to any improved material is an elevated extinction coefficient. However extinction is not the only area in which improvements are possible and desired. Improvements in the environmental impact, toxicological and other safety aspects of battlefield and training smokes are becoming increasingly important, particular with the increasing potential for urban scenarios. Biologically derived materials will show considerable improvement over inventory in these safety and environmental areas.

The current high interest area for improved materials is the infrared region, particularly in the 3-5 and 8-14 micron wavelength bands. For this application ideal materials are submicron to nanoscale particles with a generally flake- or disk-like shape with high aspect ratio (diameter:thickness) and significant electrical conductivity (equal to or greater than graphite). The secondary interest is “multispectral” screening ranging from the visible or near-infrared to the millimeter range. For these applications a desirable particle would be a submicron fiber, again with high aspect ratio (length:diameter) and conductivity. More details on the theoretically ideal are available in the references. More recent theoretical work has been completed but has not yet been

published. The results of this work indicate that the ideal particles are either fibers which are 20nm in diameter by 4 microns in length made of materials with electrical conductivity at least 105 mho/cm or flakes which are 4 microns in diameter by 0.8nm thick with conductivity in the same range. There are quite a number of approaches to applying biological systems to this problem. To suggest a few as seeds for thought: Biotic or biomimetic particles chosen specifically for size and shape characteristics and monodispersity could be treated or coated to provide conductivity. In this case, the dimensions described above for ideal materials apply specifically to the coating dimensions. Biological systems could be engineered for controllable generation of particulates. Biological macromolecules could be investigated to use the microwave activity observed by Davis and Edwards. Self assembly of macromolecules could be devised to produce appropriate particles or coar particle with appropriate conductive layers. Bacteria, for instance, magnetotactic strains, could be engineered to generate particles.

The smoke and obscurant characterization capabilities at the Edgewood Chemical Biological Center (ECBC) would be made available to provide laboratory demonstration and to provide data that are directly comparable to an existing extensive database of smoke material characteristics. This would be at no cost to the SBIR contractor. Additional issues to be considered in devising smoke materials are deagglomeration, aerosolization, achievable packing density, cost and weight. In the realm of nanoparticles, deagglomeration and aerosolization are particularly challenging issues.

PHASE I: During Phase I initial materials will be developed and evaluated in any form convenient considering the manufacture process. Materials sufficient for evaluation will be provided to ECBC. These may be either dispersed in liquid at a known concentration (10ml quantities), provided as powder for liquid dispersal (100mg quantities) or provided in powder form suitable for aerosolization through gas nozzles (10g quantities). The goal of phase I will be to prove feasibility of improved smoke through biology by achieving extinction coefficients as good or better than current inventory materials and to show initial progress toward making significant improvements over inventory smokes.

PHASE II: Phase II will address the more challenging aspects of manufacture scale-up, control of aggregation and agglomeration, and aerosolization. The goal of phase II will be to demonstrate a smoke of biological origin that provides a factor of 4 improvement over inventory smokes and is proven suitable for aerosolization and scale-up manufacture.

PHASE III DUAL USE APPLICATIONS: Although the application of obscuration is specific to the military, the overall areas of nanoparticles and interactions between the biological and mineral worlds at the nanoscale are not. Technology developed in these areas have applications in antiviral and antibacterial activity, nanophase structural materials, and chemical and biological sensors based on the unique properties of materials in the realm between quantum and microscopic.

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1. Embury, J.F. “Extinction by Clouds Consisting of Polydisperse and Randomly Oriented Nonspherical Particles at Arbitrary Wavelengths” Optical Engineering 22(1) 71-77(1983).
2. Davis, C.C. and Edwards, O.S. “Direct Excitation of Internal Modes of DNA by Microwaves: Bioelectrochemistry and Bioenergetics 16, 63-76 (1986).

KEYWORDS: Obscuration, Attenuation, Biotics, Biomimetics, Particles, Nanoparticles, Fiber, Flake, Extinction, Infrared, Millimeter, Electromagnetic Radiation

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CBD02-103 TITLE: Chemical Protective Gloves with Enhanced Properties

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Program Manager - Soldier Equipment

OBJECTIVE: Explore nanoscale phenomena to develop novel materials and a solvent less process for the manufacture of tactile, durable, flame retardant, solvent resistant gloves impermeable to liquid chemical warfare (CW) agents.

DESCRIPTION: The 7-, 14-, and 25-mil-thick chemical protective gloves currently used by the military are made of butyl rubber reinforced with carbon black [1]. They are produced by a solvent dipping process. The gloves are neither resistant to petroleum-type solvents, oils and lubricants nor to flames. However, they show excellent resistance to liquid CW agents and to oxygenated-type solvents. With the incorporation of inorganic nanoparticles into select polymers, it may be possible to improve their resistance to CW agents and at the same time take advantage of their other features, such as good resistance to solvents, abrasion and aging. It has been shown that inorganic nanoparticles dispersed in a polymeric matrix have a tendency to form layers through its thickness, thus enhance barrier properties of polymers [2]. Moreover, the inorganic nature of these nanoparticles and their intumescent properties may impart flame resistance and thus eliminate the need for adding flame retardant chemicals into formulations [3]. Furthermore, these new materials should be amenable to solvent less processing techniques, such as injection molding, blow molding, spraying/sintering, or aqueous/emulsion dipping.

PHASE I: Select candidate polymers and fabricate glove materials in the laboratory. Determine pertinent physical and mechanical properties, and also resistance to permeation by CW agents.

PHASE II: Optimize the best candidate materials selected in Phase I. Develop a cost effective, non-polluting, solvent less process for the manufacture of gloves. Produce gloves in 7-, 14-, 25-, and 35-mil thickness for laboratory testing and field evaluation.

PHASE III DUAL USE APPLICATIONS: Butyl gloves are widely used in industrial applications. Improvements either in properties of materials, such as flame retardancy and abrasion resistance, or process, which would lower the volatile organic compounds (VOC) content, will readily find commercial acceptance. Other potential commercial applications for materials containing nanoparticles include coatings for tentage and for special purpose protective suits needed for domestic preparedness activities.

REFERENCES:
1. Military Specification, MIL-G-43976C," Gloves and Glove Set, Chemical Protective".
2. E.P.Giannelis, Advanced Materials, 8 (1996), "Polymer Layered Silicate Nanocomposites".
3. J.W. Gilman, et al., SAMPE Journal, 33 (1997) , "Nanocomposites: A Revolutionary New Flame Retardant Approach".
4. J.W. Gilman, et al., "Recent Advances in Characterization and Processing of Flame Retardant Polymer Nanocomposites", Abstracts American Chemical Society, Spring 2001 Meeting, San Diego, CA.

KEYWORDS: Gloves, Elastomers, Polymers, Nanomaterials, Nanoparticles, Chemical Protection

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CBD02-104 TITLE: Remote Surface Contamination Sensor

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Nuclear, Biological, and Chemical Reconnaissance Systems

OBJECTIVE: Demonstrate proof of principal of an optical technology for remote (one or more meters) detection of contamination (oil, chemical, fuel) on solid surfaces.

DESCRIPTION: One of the more significant threats to combat systems is the potential for enemy use of a persistent chemical warfare agent. The common persistent agents such as the nerve agent VX are characterized by very low vapor pressure, thus presenting a contact as opposed to a vapor hazard. These agents can be employed to deny key terrain and avenues of approach, or interfere with airfields and logistics systems. Once such an agent is deployed, detection becomes difficult. Current Defense Department Nuclear, Biological, and Chemical (NBC) reconnaissance systems employ contact sensors to detect and identify contaminants on surfaces, obligating the reconnaissance system to become contaminated itself in the process of monitoring and marking the limits of contamination. Optical methods for the detection of contamination on surfaces, although technically quite challenging, are not unheard of.. Infrared spectroscopy can be useful in the identification of chemical materials on surfaces by providing vibrational spectral information. However, the introduction of Reststrahlen effects makes the effective use of

reflectance spectroscopy for unambiguous identification impractical. Nevertheless, some information may still be extracted from the infrared reflectance data using, e.g., the Kubelka-Munk formalism (1948). The Reststrahlen bands themselves are often employed in the identification of minerals (see for example Bower, 1998). The Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS) technique, though optimized for the study of powders, has been applied to trace quantities of liquids adsorbed onto solid surfaces (Fuller and Griffiths, 1978).

The Kubelka-Munk, Reststrahlen, and DRIFTS approaches cited here should be taken as potential approaches for the solution of the surface contamination detection problem. This solicitation is open to any innovative application of an optical technique for surface contamination monitoring (e.g., Raman LIDAR, laser-induced breakdown, and vapor generation by remote heating with subsequent IR sensing of the vapor spectra).

PHASE I: Demonstrate, through rigorous theoretical modeling and controlled laboratory data, the proof of principal of the proposed solution. Construct preliminary library of surface properties accessible by the technique and describe suitable algorithm for automation of the sensor technology.

PHASE II: Construct a prototype optical sensor and integrate signal acquisition and analysis for autonomous alarm operation

PHASE III DUAL USE APPLICATIONS: Outfit Defense Department Nuclear, Biological, and Chemical (NBC) reconnaissance systems with a forward-looking contamination detector. Commercialize and market a surface or soil contamination monitor for industrial and environmental applications including engineering reactor cleaning, hazardous spill remediation, and land reclamation.

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KEYWORDS: Surface Contamination, Optical Reflectance, Differential Albedo, Diffuse Reflectance, Reststrahlen, Kubelka-Munk, Light Detection and Ranging (LIDAR), Laser-Induced Breakdown Spectroscopy (LIBS)

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CBD02-105 TITLE: Novel Conjugation Sites for Antigen Binding Reagents

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: Development of novel conjugation sites for next generation recombinant antibody and nucleic acid reagents.

DESCRIPTION: Fully characterized, standardized and validated reagents (antibodies, antigens, and gene primers/probes) are critical for the detection and identification of Biological Warfare (BW) agents. For Biosensors use, immunoglobulins (IgG) are easily and routinely modified by attachment of reporter molecules to conjugation sites (amines and sulfhydryl groups). While recombinant antibodies [antibody binding fragments (Fab'), single chain fragments (scFv)], RNA ligands (aptamers) and peptides possess antigen binding sites, conjugation sites are frequently eliminated and would require reengineering to add new conjugation sites. In addition, the placement of reengineered conjugation sites is critical to avoid steric hindrance of the antigen binding site due to the small size of the reagents. This may be resolved by the addition of chemical spacer arms (tethers) that separate the detector molecule from the reagent antigen binding site. Additionally, selective chemical placement of reporter molecules (enzymes, lanthanides, heavy metal chelates, and fluorophores) commonly used as reporter molecules is not a straightforward science known to most end-users and is not optimized for sensitivity and steric hindrance avoidance. We propose research in conjugation chemistry which addresses the following:
-development of novel conjugation sites for attachment of reporter molecules on engineered antigen-binding molecules
-development of novel chemical spacer arms to separate the antigen binding site from the reporter molecules

PHASE I: Identification of new conjugation chemistry/spacer arm techniques with successful testing for antigen binding and stability on an engineered antigen-binding molecule.

PHASE II: Test successful Phase I techniques on recombinant antibodies, aptamers and peptides. Tailor reagents where necessary to attach to a variety of substrates, such as glass, paramagnetic beads and titanium alloys. Compare reagents against current antibody-based systems for improved sensitivity and cost savings. Development of large scale "kit" for labeling reagents.

PHASE III DUAL USE APPLICATIONS: Adapt and test labeled reagents in biosensors including DoD diagnostic hand-held assays, sensors for industrial process control and medical diagnostics.

KEYWORDS: Conjugation Chemistry, Biosensors, Reporter Molecules, Antibody

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CBD02-106 TITLE: Improved Field Biosensor for Organophosphates

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: The objective is to design, develop, and produce a versatile personal biosensor or badge for detecting organophosphates (OPs). The badge must overcome limitations of the current sensors (M272 and M256A1 kits and the M18A3 nerve agent detection ticket) for testing G and V agents in any environment. While current kits can detect OPs only in air or a drop of liquid, they cannot be used for sampling water and soil. Additionally, it is advantageous if the badge/biosensor could provide a qualitative indication of the type of OP in the field in real-time. The ability to identify the G or V agent in the field would aid in treatment, in securing the contaminated area, and in the identification of illegal use of OPs. The badges must provide sensitivity and selectivity, limit false readings, and therefore consist of immobilized or enduring enzymes to prevent leaching to the environment. Lastly, the badge must be lightweight, and require no energy source for qualitative results or require minimal power (a battery for up to several months) using hand-held optical units.

DESCRIPTION: The US Joint Services, Federal Agencies, and state and local First Responders are currently using the M256A1 kit to detect G and V agents. Although the M256A1 kit has performed well and meets US Army requirements, numerous shortcomings have been identified through feedback from military and agency users. There are several criteria for a viable biosensor suitable for field deployment. The sensor must have a size, weight, and power consumption that is small and in a hand-held electronic unit, use for months without battery exchange, yet be rugged if it is to be a personal kit. The sensor must overcome human factors; at the very least, be easy to use. The detector must sense all the OPs to which the human enzyme is sensitive, yet be selective for OP compounds or pesticides. Enzyme sensors have had the advantage of selectivity, sensitivity and, most important, specificity, ease and portability, and markedly simplified instrumentation. Biosensors of enzyme can behave as a dosimeter, accumulating only those OP inhibitors demonstrating exquisite selectivity for the specific enzyme, while ignoring other environmental interferences. Enzymes act as very rapid biological amplifiers. The unit must have a low false rate, respond in a rapid manner, and function under diverse conditions such as in the night. The badge must be sensitive to a wide variety of test conditions, for example, determining whether drinking water, air, soil, or the general environment, or a soldier's clothes and equipment have become contaminated with OPs. The unit must have a long and stable shelf life. A significant advantage would be field identification of the specific OP chemical warfare agent, which might be accomplished by using multiple differentiating enzymes.

PHASE I: Phase I research will be restricted to showing feasibility of producing biosensors that could readily replace current G and V agent components in the M256A1 and M272 kits, while meeting the criteria of detecting the agents in diverse environmental conditions, including water and soil, i.e., overcoming the shortcomings of current kits. This means that the enzyme(s) must not leak from the detector. In addition, the improved/modified biosensors must be designed to meet/exceed other current M256A specifications (that meet feasibility testing during this short time frame), such as accelerated stability testing to ensure a long shelf life of the new product. Considerable innovation is required to develop enzymes that can function in harsh environments and not leach from the substrate matrix.

PHASE II: Define and develop detection schemes for identification of the type of G or V agent that might be present in the field, consistent with the criteria of Phase 1. The biosensor could be composed of different enzymes, producing qualitative colorimetric changes and/or placed in a hand-held spectrophotometers with built-in intelligence so the rates of inhibition of AChE, BChE, and other suitable enzymes could be directly determined. Complete studies demonstrating that the biosensor meets/exceeds M256A1 and M272 specifications for G and V agents including sensitivity, aging, interference, user evaluation, blank response tests, sensitivity tests, etc. Substantial innovation is required to develop a scheme of procedures/enzymes to differentially indicate in the field the specific G or V agent(s) while meeting the requirements described in Phase 1. Live agents will be required to test the biosensor; possible sources for testing include industrial (Battelle) and academic laboratories permitted to use the G and V agents.

PHASE III DUAL USE APPLICATIONS: (1) Produce biosensors, including differential sensor, for replacement of current kits used in the military and civilian use to be incorporated into current kits with as little re-engineering as possible. (2) Prepare a

hand-held version so that information could be transmitted to a central facility to monitor for toxic OP clouds or the transportation of OPs in water. Participate in dual civilian use (e.g., First Responder testing).

A) There must be a rapid and effective means to determine potential OPs that might occur from a terrorist act if first responders are to effectively contain the chemical agents. It is important that there be a civilian field unit capable of rapid qualitative detection of OP contamination in water, skin, and other surfaces. A quantitative method should also be available for monitoring exposure in the field, i.e., a hand-held unit. The ability to identify the OP toxin in the field and confirmation in the lab would aid in treatment and securing any contaminated area. B) An inexpensive OP sensor could be used to monitor exposure (immediate and long term) to pesticides in the field. This is of particular importance since there is increasing use of and poisoning by pesticides. C) Biosensors composed of human or other suitable cholinesterases, which would provide these detection sensors with the same sensitivity to organophosphates as human beings, could be a home product to ensure food free of pesticides.

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KEYWORDS: Biosensor, Enzymes, Cholinesterases, Organophosphorus Hydrolases, Phosphotriesterases, Organophosphorus Chemical Warfare Agents, Pesticides, Terrorist, First Responders

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NAVY CBD SBIR TOPICS

CBD02-200 TITLE: Destruction of Chemical and Biological Agents and Hazardous Medical Waste using a Hybrid Microwave System

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Program Manager, Marine and Nuclear, Biological, and Chemical Defense Equipment

OBJECTIVE: To evaluate the potential of microwave energy as a potential method to destroy chemical & biological agents and medical waste. Basic research at NASA, the DOE Savannah River Site, and in private sector labs in Japan / Europe have explored the potential to use microwave energy as an efficient waste destruction method. Some of this research utilized microwave energy as a waste destruction and disinfection mechanism while other work explored the treatment of the off-gases produced in the destruction process. Because of the wide range of materials associated with chemical and biological agents and medical waste streams, before scaled-up prototype systems are built from the current exploratory work, the need exists for an evaluation process and small scale testing, perhaps utilizing data modeling systems, to determine if microwave energy could indeed provide the destructive ability to treat these chemical and biological waste streams in an efficient manner.

DESCRIPTION: Chemical and biological agents are being stockpiled in a variety of sites and the threat of facing such agents in warfare presents a significant concern to the health and safety of military and civilian personnel and the environment. Concern is growing over the safe disposal of existing chem-bio stockpiled materials and how to also safely process the materials that are required to produce, handle, and store them. Contamination can come from the chem-bio agents themselves and also from all equipment and materials used to produce, handle, and transport them. This equipment can include everything from personal protection gear (face shields, gloves, suits, shoes, etc.) to maintenance equipment used to contain or absorb contaminated liquid material (mops, containers, plastic draping, duct tape, etc.) DoD identified need centers on an ability to dispose of chemical and biological warfare materials in ways that pose the least risk to military and civilian personnel and the environment.

DoD currently utilizes a complex system of incineration (kiln) systems with associated scrubbers to ensure emissions are within regulatory guidelines and to render harmless chemical and biological agents. These incinerators are under increasing scrutiny from local and federal environmental regulatory agencies, and restrictions on their level of emissions continue to increase. In addition, the complexity of their operation makes them expensive to operate and increases the likelihood of frequent equipment malfunction or failure. Further, current disposal processes pose threats to the safety and health of operators and maintenance personnel because of their exposure to sharps and biological material in the transport, operation, and disposal steps. In addition, current kiln systems are not suitable for field/portable operation. Because of the potential of facing chemical and biological agents in a real engagement somewhere in the world, the ideal treatment system would be portable, allowing destruction of materials at the point of origin, rather than requiring expensive and high-risk transport back to the U.S. Such issues give rise to alternative technologies.

There is a corresponding private sector need that exhibits many of the same dangers of processing, handling, transport, and disposal seen in the DoD chem-bio challenge. Infectious medical waste can pose a serious biological threat by exposing health care professionals and maintenance personnel to materials that may contain bloodborne pathogens (such as the hepatitis B virus and HIV/AIDS virus). Correspondingly, significant volume of medical waste is also generated at most military installations and onboard ships as well. The nation's 6,323 hospitals generate an estimated four billion pounds of medical waste annually.

As is seen in the chem-bio arena, the medical waste risk is present in the actual pathogens but these pathogens also contaminate the materials that are used for personal protection, handling, transport, and disposal. These medical-related materials include blood-exposure components (plastic IV bags, needles, syringes, lancets, and scalpels) but also personal infection control products such as caps, gowns, face masks, latex gloves, and surgical drapes.

There are two primary disposal methods of choice that are currently used to handle medical waste: (a) incineration and (b) landfilling. Both disposal methods expose health care and sanitation workers to infectious material, and incineration emits significant environmental pollutants to the general population. The environmental threat of medical waste incineration was reflected in the August 19, 1997 Environmental Protection Agency (EPA) Final Rulemaking (Code of Federal Regulations, 40 CFR, Part 60) which will severely restrict incineration of medical waste and close down 80-95% of such facilities in this country. This regulatory mandate outlines limits for particulate matter, carbon dioxide, dioxins and furans, hydrogen chloride, sulfur dioxide, nitrogen oxides, lead, cadmium, and mercury.

The need exists for an innovative technology that will treat a wide range of chemical and biological material, eliminate its threat to human health, and perform this function in a manner that does not pose significant risks to human or environment health and safety. Microwave energy may provide this solution but early-stage evaluations must be conducted to see if this field warrants additional exploration and development. The proposed testing will assemble the targeted waste streams and materials in the chemical, biological and medical waste fields and assess the theoretical potential of microwave energy to destroy the waste and reduce its environmental impact.

PHASE I: The work conducted under Phase I of the proposed research would establish the credibility that indeed microwave energy could be viewed as a viable destruction and effluent treatment system. Due to the known array of liquids and solids in the

chemical and biological defense field and the range of medical waste materials (plastics, glass, metals, paper, tissue, nonwovens) encountered in both the military and commercial sectors, the candidate system must demonstrate an ability to accept and treat a wide range of components to be considered a viable alternative technology to existing methods of destruction. This will mean treating actual or simulated wastes to determine the potential feasibility and flexibility of such a system. In addition, the configuration of such a system must also be proposed. In some of the early stage experiments in Japan, industrial-sized microwaves are envisioned while other work at DOE suggests smaller, point-of-origin systems that could be used at a DoD base or in the case of medical waste, at a clinic or operating room.

The throughput capacity and economics of the proposed system must be evaluated to be seen as a viable alternative. Potentially, microwave modeling techniques may be employed to provide an early-stage confirmation of the potential for microwave energy to be considered a viable waste destruction alternative.

PHASE II: From this applied research and preliminary technology development in Phase I will come the creation of a working, scaled-up prototype in Phase II of the SBIR. An actual working system would be devised and built. Actual chemical and biological agents and targeted waste materials would be introduced into the system and its destruction and off-gas treatment capabilities would be assessed. Key considerations would be its ability to destroy a significant (75%+) volume of the material, eliminate any hazardous or infectious potential, and produce waste gases that are well within known federal standards for such treatment applications. Temperature measurements will be taken within the microwave heating area to determine if the 5x decontamination level of FM3-5 can be attained for chemical agent destruction.

PHASE III DUAL USE APPLICATIONS: From the development of a working prototype in Phase II will come key learning about the performance of the system and how to modify it to achieve the cleanest, most cost efficient destruction process. This learning will allow the installation of a beta test unit into (a) military installation and (b) a private sector medical center where its performance can be monitored in actual use situations.

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KEYWORDS: Chemical, Biological, Hybrid, Microwave Energy, Waste Destruction, Contamination

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CBD02-201 TITLE: Diver Worn Equipment for Diving in Chemical/Biological, Toxic Industrial Chemical and Toxic Industrial Material (TIC/TIM)

TECHNOLOGY AREAS: Chemical/Bio Defense, Human Systems

OBJECTIVE: To develop diver worn equipment suitable for protecting a diver receiving breathing air from a surface supplied source while diving and working in chemical, biological, toxic industrial chemical, toxic industrial material (TIC/TIM), and chemical warfare agent (CWA) contaminated environments.

DESCRIPTION: Worldwide, water conditions have become increasingly more dangerous to both military and commercial divers due to chemical, biological, toxic industrial chemical, toxic industrial material (TIC/TIM) and potential chemical warfare agent (CWA) contamination. Additionally, with stringent regulations governing personnel exposures, the need exists for an improved surface supplied diver worn system that will prevent the exposure of the working diver to these contaminated environments while fulfilling the mission. Recent developments in diving helmet design have demonstrated the feasibility of significantly improving the breathing gas/water interface performance capabilities and the ability to keep contamination in the surrounding water from entering the helmet.

PHASE I: Develop and demonstrate a conceptual demand regulator and exhaust valve system for demand type diving helmets, in particular the underwater breathing apparatus (UBA) MK 21 MOD 1/Superlite 17B, when used in water contaminated with chemical, biological, TIC/TIM and CWA contaminated environments. Contaminants to be considered include flammable liquids such as hydrocarbons (petroleum products, benzene, ethers, ketones), oxidizing agents such as halogens and acids, biological agents such as raw sewage and its derivatives such as pfisteria and e-coli bacteria, antifouling paints such as tributyltin (TBT), creosote, and traditional chemical/biological agents such as GB (sarin), GD (suman), HD (mustard), and VX. The regulator, exhaust valve and their component materials must be impermeable to and not degraded by the subject contaminants for the mission period, usually 4-6 hours. The contractor shall conduct laboratory evaluations to demonstrate that the conceptual regulator and exhaust valve do not permit the simulated contaminants to enter the helmet or breathing loop. Performance of the breathing regulator and flow of breathing gas through the breathing loop must not be degraded from current performance levels.

PHASE II: Refine conceptual demand regulator and exhaust valve systems and integrate into the UBA MK 21 MOD 1 diving helmet. Conduct laboratory evaluations of the modified helmet to demonstrate that it's work of breathing has not increased over current levels. Evaluation should also show that the chemical and biological agent simulants do not penetrate the helmet/breathing loop environment for the entire mission period regardless of the work level. Independent chemical testing shall be conducted of regulator and exhaust valve components to demonstrate that there is no degradation or permeation of the components for the full mission period. Conduct an assessment of CWA/TIC/TIM vulnerabilities of the UBA MK 21 helmet and identify and validate methods for "hardening" the helmet prior to contamination. Determine and verify materials and methodology for decontaminating the helmet after contamination.

PHASE III DUAL USE APPLICATIONS: Provide a final product consisting of a UBA MK 21 MOD 1 diving helmet with fully demonstrated and documented demand regulator and exhaust valve for contaminated water diving. Conduct testing with helmet connected to Navy approved dry suits with integral neck dam to demonstrate integrity of the entire diver protective environment. The final product should include procedures for chemically hardening the helmet and helmet/suit interface prior to diving in a contaminated environment and procedures for decontamination of the helmet after contamination.

This new product will significantly improve safety for commercial divers working in hazardous waters. Up to ninety percent (90%) of the surface-supplied diving helmets used by commercial oil and salvage divers in the United States are the same as those used by the U.S. Armed Forces. These particular helmets are the standard in the industry.

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KEYWORDS: Contaminated, Water, Chemical/Biological, Toxic, TIC/TIM, Diving, Helmet, Surface-Supplied, CWA

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CBD02-202 TITLE: Improved System and Methods for Evaluating Protective Material Performance to Chemical Agents

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes, Human Systems

OBJECTIVE: To develop a system that can effectively test the permeability of clothing materials to chemical warfare agents under a variety of simulated real-life scenarios. The system should be safe, efficient (allowing maximization of test throughput), reliable, relatively inexpensive, and capable of providing real-time data over a wide range of analyte concentrations. The final product will be a laboratory test system and methodology that will allow the delivery of agent under defined test conditions, perform real-time assays, and present data in a usable form. Information generated from this system will be useful to: materials manufacturers who, through the analysis of real time permeation kinetics can better understand the mechanisms of breakthrough and ultimately develop better products and end-users to determine the safety limits of various materials employed in protective garb for the battlefield.

DESCRIPTION: The use of chemical warfare agents on the battlefield has become a highly visible issue in recent years. Currently, the number of nations possessing a chemical warfare capability is increasing, as is the possibility that members of the U.S. military may suffer exposure to chemical agents on the battlefield. A major element in the protective ensemble is a protective garment that is impermeable to chemical warfare agents. This can only be made possible through effective engineering, fabrication and testing of the component materials of the uniform and then finally the testing of the uniform configuration and design.

Current testing systems rely on relatively antiquated “wet chemistry” assays which are expensive, labor intensive, and do not allow acquisition of real-time breakthrough data. The kinetic profile of agent permeation is not presently attainable. In addition, test set-up is currently performed by human technicians hand delivering dangerous agents without the aid of robotics. Current systems allow little variation in testing environment. The proposed system will allow testing without any of the above obstacles. Specifically, a variety of agent delivery modes (liquid, droplet, gaseous) will be accommodated and a number of environmental conditions will be precisely controlled (temperature, relative humidity, flow rate, contaminants).

PHASE I: The contractor shall design and demonstrate a system that can provide environmental control (temperature, relative humidity, presence of “contaminants”); allow safe analyte challenge through liquid, aerosolized droplet, and gaseous exposure; allow multiple materials samples to be tested simultaneously; and allow real-time chemical assay with the capability to process the sensor signals and provide “user friendly” breakthrough data. The contractor should demonstrate the potential of the system to address the present needs with “simulant agent tests”.

PHASE II: The contractor shall finalize system designs and develop a fully functional prototype that addresses the challenge, testing, sensing, and processing requirements described above. The contractor shall demonstrate improved materials testing system performance by virtue of live chemical agent testing in parallel with existing systems and methods. All live agent testing will by a currently approved surety laboratory.

PHASE III DUAL USE APPLICATIONS: The final product will be a fully integrated, tested, and verified materials testing system capable of providing real-time, quantitative chemical permeation performance. The system will have advanced the field of materials testing by: offering more realistic and diverse test scenarios to be tested; improving testing controls and methodologies; reducing testing logistics and costs; and, most importantly, providing real-time insight to material performance to chemical agents. The implications of this system would be far reaching and ultimately provide improved systems and an improved level of safety for troops. The system benefits could be extended to serve non-military material industries and provide an improved quality of life to millions of users of chemical protective products.

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2. ASTM Standard F903-99a: "Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Liquids" Standard F 903-99a, West Conshohocken, Pennsylvania: American Society for Testing and Materials (August 1999)
3. "Permeation and Penetration Testing of Air-Permeable, Semi-Permeable, and Impermeable Materials with Chemical Agents or Simulants (Swatch Testing)" U.S. Army Test and Evaluation Command Test Operations Procedure (TOP) No. 8-2-501 Defense Technical Information Center, AD No. A322329, Dugway, Utah: U.S. Army Dugway Proving Ground (March 3, 1997)
4. "Field Behavior of NBC Agents (Including Smoke and Incendiaries)" Field Manual No. 3-6 Air Force Manual 105-7 Fleet Marine Force Manual No. 7-11-H Washington D.C.: Department of the Army, Department of the Air Force, United States Marine Carps (November 3, 1986)
5. "NBC Defense, Chemical Warfare, Smoke, and Flame Operations" Field Manual No. 3-100 Fleet Marine Force Manual No. 11-2, Washington D.C.: Department of the Army, U.S. Marine Corps (May 23, 1991)
6. "NBC Protection" Field Manual No. 3-4 Fleet Marine Force Manual No. 11-9, Washington D.C.: Department of the Army, U.S. Marine Corps (May 29, 1992)
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KEYWORDS: Chemical Agent, Chemical Protection, Materials Testing, Sensors, Nuclear, Biological, and Chemical Survivability

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CBD02-203 TITLE: Multi-TIC Colormetric Badge

TECHNOLOGY AREAS: Chemical/Bio Defense, Human Systems

ACQUISITION PROGRAM: ACAT IV: Program Manager MARINE Nuclear, Biological, and Chemical, Combat Supoort Logistics Equipment (CSLE)

OBJECTIVE: To develop a light-weight, wearable device for detecting and alerting the wearer of low level exposure to Chemical Warfare Agents (CWA) and high priority Toxic Industrial Compounds (TICs).

DESCRIPTION: Challenges faced by the military while operating in a chemically threatened environment are compounded by the inability to rapidly and accurately detect low-level exposure to CWAs and select TICs. This topic seeks the development of a wearable monitor that can act as a personal alarm for individual soldiers who may be required to operate in these environments. The Military currently addresses chemical agent threats with area and point detection systems, protective clothing, masks and medical care (1). The sensitivity of the area and point detection systems are limited and can be compromised by chemical aromatics and other common compounds often present in a battlefield. These devices work well as gross level detection devices. However, they are not currently designed as personal low level exposure alarms. Additionally, the performance of protective clothing and masks can be compromised by wear and tear as well as misuse. Individual exposures to low concentrations of CWAs may cause cumulative effects, could temporarily or permanently cause harm or even death. (2). A personal chemical monitor that alerts the wearer when he/she has been exposed to a CWA at concentrations less than the Immediately Dangerous to Life and Health (IDLH) level would greatly improve the safety and fighting capabilities of our armed forces. The chemical

monitor will be particularly useful to Special Forces war-fighters who often find themselves in solitary environments where support personnel and equipment is generally not available.

The sensor needs to be compact and lightweight, unobtrusive, easy to use and maintain, field rugged, stable in all operating environments, able to be worn with clothing or personal protective equipment (PPE), require no environmental protection (i.e., special storage) and must provide rapid accurate detection with a low false alarm rate. As an objective capability, the sensor must datalog time, temperature, humidity, agent type and concentration, and sensor status for subsequent download. Sensor indications and controls must be night vision compatible. Sensor alarms must incorporate silent alarm techniques and adjustable audible alarms.

PHASE I: In this period the contractor is to demonstrate proof-of-concept of a potentially successful approach for the sensor used in the monitor CWAs and TICs. "Innovative" or "creative" approaches to meeting the technical goals should be demonstrated to indicate that the proposed concept can provide the basis for a successful program.

PHASE II: It is expected that in this period a working prototype of the complete monitor will be available. The prototype should contain the essential features of the envisioned final product. Testing for sensitivity, specificity, stability, and logistics supportability will be conducted. Considerable innovation will be required to improve the sensitivity and selectivity classic and emerging CWAs and TIC while maintaining confidence and a low false alarm rate.

PHASE III DUAL USE APPLICATIONS: Produce sufficient quantities to allow independent testing, operational assessment, and transition to ongoing joint or service specific programs. In the commercial sector, it will provide protective measures for safety personnel fighting a terrorist chemical attack; for law enforcement personnel who investigate chemically compromised urban environments; and for manufacturers and handlers of pesticides and fertilizers, such as agricultural workers.

REFERENCES:
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3. ITF 25 Report "Threat from Industrial Chemicals", 18 March 1996
4. Threat Environment Projection: Chemical and Biological Warfare 2000 - 2025 (PC-1600-32-95)
5. Operational Requirements Document for the Joint Modular Chemical/Biological Detection System (JMCBDS) Revised Final Draft, 20 July 2000, JTD: J2U003-I

KEYWORDS: Colormetric Badge, Chemical Warfare Agents, Toxic Industrial Compounds, Wearable Monitor, Personal Protective Equipment

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CBD02-204 TITLE: Modular Environmental Situational Awareness Technology

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: NAVSEA 05R: Operational Naval (OPNAV) Group

OBJECTIVE: The object of this project is to explore, through research, the technical feasibility and then develop a modular suite of lightweight, rugged, field maintainable sensors capable of acquiring weather, pollution, geographic and seismic data that would be easily tailored for any a wide variety of missions. This modular suite would be used for the purpose of integration into Chemical/Biological detection systems and downwind hazard area prediction and modeling software/hardware applications. This new system would allow for intelligence operations to obtain pin-point source attribution and on-scene meteorological conditions, without having to rely on outdated ground force or satellite information.

DESCRIPTION: As part of the Intelligence Community of the 21st Century study it is reaffirmed some long held beliefs about the relatively unpredictable future – especially in terms of specific technologies the Community will face. One truism that seems to hold is that the sophistication of the technologies employed in the future weapons system (threats that the IC will be tasked

against) will be radically improved, and perhaps even more radically different than those we attempt to understand today. The resulting need for a more sophisticated IC collection capability, with source attribution identification, is clear. However, as the sophistication of these targets increases, or as countries (Transnational/National players) employ effective denial and deception techniques, we will need to employ new capabilities to ensure we can continue to answer the consumer's questions.

The requirement for these efforts is a miniaturized low-power, modular environmental situational awareness system. More specifically, the effort requires a enclosed, portable, scaleable, real-time, stand-alone environmental analysis mass flow controlled system. This system must be able to push beyond the already available weather/pollution monitoring systems with development in state-of-the art micro-sensor [infrared, Time-of-flight [TOFr] Tetrahertz, Nano, Neutron-Based), technologies. The system should be able to collect total suspended particulate low to high volume [feasibility range 5 cfm – 150 cfm] of ambient air sampling, with wind speeds from 0 – 165mph, accuracy of less than 1% and minimum resolutions of 0.05m/s. Integration of ultraviolet sensor detectors in germicidal wavelengths to long-range ultraviolet rays of 280 nanometers (nm) [UV-B] to 400 nm [UV-A]. The system enclosure should be man-portable, preferably within the dimensions of 3' x 3' x 3' and be able to operate in a multi-operational temperature/condition range of 00 to 700 C. Maximum weight should not exceed 200 lbs and operate on 120VAC and consume no more than an average continuous power of 25 Watt. The system design should have applications for interchangeable weather and pollution monitors/sensors, computer controller, 1553 data bus, automated analysis process for source attribution analysis and automated report generation in unidentifiable output code format.

PHASE I: In Phase I, development of a breadboard design concept for a miniaturized, modular environmental situational awareness system. This integrated breadboard concept should be able to recognize sensory inputs of the following meteorological conditions; (1) identification of wind speed and direction, visible light, UV-A and UV-B and siphonable precipitation gauge and this project should recognize for at least two of the following environmental/pollution sensory inputs; (2) Nitrous Oxide, Sulfur Oxide, Carbon Dioxide and Ozone.

PHASE II: Improvement of system performance, from Phase I and analysis of system level alternatives should be performed. Build, test against the performance of the system design and deliver an advance concept technology demonstrator of the miniaturized modular environmental situational system.

PHASE III DUAL USE APPLICATONS: Prepare and develop full ownership identification, military and/or commercial opportunities for technology transfer into existing military or IC community users. Move program into full development and integration testing. Integration; test performance of the system against fleet existing Chemical/Biological systems utilizing a subset of agents, simulants and interferents, under multiple environmental conditions. Impact programs could be: Chemical and Bilogical Defense-Contamination Avoidance; Counterproliferation-Strategic and Tactical Intelligence, Battlefield Surveillance and Damage Assessment, Domestic Preparedness.

This system or systems has commercial targets that include but are not limited to: biotech/pharmaceutical research, chemical process monitoring, air/water environmental monitoring and testing, academia, and explosives analysis/development. It is conceivable that this technology could create new markets where previously capability, and/or analytic results prohibited consumers the luxury of existing tools.

REFERENCES:
1. Road Map for National Security: Imperative for Change; The Phase III Report of the U.S. Commission on National Security/21st Century, January 31, 2001; JP 3-40, Joint Doctrine for Counterproliferation Operations; Joint Vision 2020 Report; CNA Mid-Atlantic Region Chem-Bio (CB) Defense Exercise Lessons

KEYWORDS: Weather, Pollution, Environmental, Sensor Integration, Weapons of Mass Destruction, Chemical/Biological Protection

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AIR FORCE CBD SBIR TOPICS

CBD02-300 TITLE: Miniaturized Real-time Visible/UV Spectrometer

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Joint Chemical and Biological Defense Program

OBJECTIVE: Develop a miniature spectrometer as a payload sensor for real-time spectral discrimination and identification of chemical agents from small delivery platforms.

DESCRIPTION: Future Air Force and DoD missions will depend on real-time detection and characterization of chemical agent clouds and vapors. Significant research is already underway for developing advanced miniature spectroscopic sensors for the purpose of chemical detection in the battlefield for passive defense. The objective of this research is to initially provide an enabling technology for a hand-held device for point detection and identification of harmful agents. Later efforts will integrate complete sensors incorporating this technology on small platforms for mapping and identification of chemical clouds in the battlefield environment. Both efforts seek to increase the maneuverability of the warfighter through exploitation of science and technology.

The requirement for these efforts is a miniaturized low-power visible/UV spectrometer. More specifically, the effort requires a single channel, enclosed, stand-alone, realtime, digitizing spectrometer with a sampling time of 100 ms and time of integration no greater than 20 ms and a signal-to-noise ratio less than 100:1. The dimensions of enclosure must be no larger than 3 in. x 3 in. x 1 in. (LWH) in any dimension. Maximum weight—not including power source—must be under 100 grams. The spectral region of operation needs to be between 200 nm – 800 nm with a maximum (worst-case) resolution of 1 nm. The device should operate on 5VDC and consume no more than an average continuous power of 1 Watt.

PHASE I: Develop a breadboard concept for the spectrometer as a step toward the miniaturized system. Design and develop a spectrometer prototype with estimated per-unit cost and performance ratings.

PHASE II: Improve system performance and revisit specification and analysis of alternatives on the system level. Build and deliver a finalized working prototype of the system, and test the performance of the system against a subset of agents, simulants, and interferents.

PHASE III DUAL USE APPLICATIONS: Chemical and Biological Defense-Contamination Avoidance; Counterproliferation-Strategic and Tactical Intelligence, Battlefield Surveillance, Battle Damage Assessment, Facility Characterization, Domestic Preparedness.

REFERENCES:
Ocean Optics Internet Web Site: http://www.oceanoptics.com/products/s2000.asp

KEYWORDS: Spectrometer, Miniature, Resolution, High, Bandwidth, Chemical, Agent

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CBD02-301 TITLE: Exploitation of Quantum Well Interactions for Electro-optical Sensor Development

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Joint Chemical and Biological Defense Program

OBJECTIVE: The goal is to characterize unique features from scattered light coupling to quantum well modes on random surfaces. Once modeled, the features may be used to improve the discriminating capabilities of surface enhanced Raman scattering (SERS) detectors, enhancing selectivity. Essentially, this effort seeks to bridge the gap between performance and support specifications for detect to warn and detect to treat systems.

DESCRIPTION: Chemicals that have similar molecular and bonding structures often have identical spectral features, making discrimination between these chemicals problematic for spectroscopic detectors. Surface enhanced Raman scattering

spectroscopy has shown promise for sensitive detection of chemical agents within the joint services agent water monitoring program, but suffers from the same limitation on selectivity. Recent work with a novel composite material for the enhancement of SERS has shown that nanoparticles (10-50 nm diameter) induce quantum well interactions with the high surface fields. These interactions, likely due to coupling between electronic states of the metal nanoparticles and the large local field intensities, reveal an extremely rich spectrum of discrete spectral lines. In some specialized experiments this spectrum extends for over 600 nm from 200-800 nm under excitation by extremely weak pump powers of only a few milliwatts. It is known that the spectral characteristics of molecules adsorbed on the metal particles will exert a strong influence on the detailed structure of the broadband emission; however, we do not currently possess a model to explain the fine structure in terms of coupling between the adsorbed molecules and the metal particles. This is an especially important area of research in the continuing development of SERS technology, since it may offer a rich selection of spectral identifiers for similar chemicals that traditionally share major features. We envision progress in this area to be the result of both experimental and numerical efforts, drastically improving the performance of successful SERS techniques.

PHASE I: Setup nonlinear optical experiment to measure and isolate the fine structure from quantum well interactions from random surface media. Perform a variable analysis to determine the factors which influence the unique features. Build theoretical and computer models to reliably explain and predict the phenomenology, confirmed by experimentation.

PHASE II: Formalize model to use as a basis for SERS detector design and analysis. Construct a prototype system to exploit the unique features, and compare performance to conventional point detector systems. Compare performance to SERS detectors that do not discriminate based on the quantum well interactions. Quantify performance against simulants, interferents, and live agents.

PHASE III DUAL USE APPLICATIONS: Chemical and Biological Defense-Contamination Avoidance; Counterproliferation-Strategic and Tactical Intelligence, Battlefield Surveillance, Battle Damage Assessment, Facility Characterization, Domestic Preparedness; Medical-Contamination Diagnostic; Toxic Handling and Demilitarization-Detection and Monitoring.

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4. T. E. Ruekgauer, J.&#64979;G. Xie, P. Nachman, and R. L. Armstrong, "Nonlinear Outcoupling of Stimulated Raman Scattering from Laser&#64979; Irradiated Microcylinders", Opt. Lett. 20, 2090 (1995).
5. R. K. Chang, and T. E. Furtak, “Surface-Enhanced Raman Scattering”, Plenum Press, New York, 1982.
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7. P. Lee, and D. Meisel, “Adsorption and Surface&#64979;enhanced Raman Scattering of Dyes on Silver and Gold Sols", J. Phys. Chem. 86, 3391 (1982).
8. Zeigler, L. D. “Hyper&#64979;Raman Spectroscopy”. J. Raman Spectrosc, 769&#64979;779 (1990).
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KEYWORDS: Surface, Enhanced, Raman, Scattering, SERS, Hyper-Raman, Composite, Random, Nanoparticle, Coupling, Quantum, Well, Interaction, Spectroscopy, Sensor, Detector

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CBD02-302 TITLE: Reactive Functionality in Fabrics and Protective Coatings

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes, Human Systems

OBJECTIVE: To develop regenerable, robust materials that will actively protect personnel, equipment, and structures against contamination by chemical and/or biological (CB) agents during and after one or more attacks.

DESCRIPTION: The candidate technology will be a polymeric material or materials incorporating (but not limited to) two types of functionality:

1. A chemically reactive component or components that can be covalently coupled to an existing or growing polymer chain—for example, an isocyanate group could condense with hydroxyl groups on a cellulose molecule or on a growing polyurethane chain—and
2. A second (not necessarily separate) moiety that is able, with or without subsequent activating treatment after incorporation into the polymeric material, to neutralize the toxic liability of a wide selection of CB agents (demonstrated examples include chloramides and quaternary ammonium triiodides).
Preparation of monomeric molecules will be sufficient for phase I of this solicitation, but preference will be given to approaches that include demonstrating incorporation of the monomers into large molecules or—better—candidate materials, and evaluation of the properties of the products. Safety and projections of rate and efficiency of neutralization, cost to produce, simplicity to use and maintain, and durability in use and storage will be major factors in the selection process.

PHASE I: During phase I the contractor will identify or prepare candidate molecules containing both the coupling and the neutralizing components identified in the preceding paragraph. Contractor will conduct a critical experiment to demonstrate, in turn, coupling to a representative functional group and [after activation, if needed] neutralization of realistic surrogate chemical and biological agents by at least one of the candidate molecules.

PHASE II: During phase II, contractor will focus on development and evaluation of prototype reactive coatings and/or fabrics. Contractor may continue development of candidate monomeric molecules during phase II. Critical experiment[s] will examine material and chemical/antibiotic properties of coatings and/or fabrics prepared from candidate monomer[s]. Samples of candidate coatings and/or fabrics will be submitted as deliverable items for testing or other evaluation at the discretion of DoD components.

PHASE III DUAL USE APPLICATIONS: During phase III it is expected that contractor will pursue dual-use applications [for example, in infection control or personal hygiene products] to promote economy of scale, in addition to securing external funds to support completion of development of a shelf-ready product or products for DoD.

REFERENCES:
1. "Durable and Regenerable Microbiocidal Textiles," US Patent 5,882,357 (1999).
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3. "Designing Surfaces That Kill Bacteria on Contact," Proc. Natl. Acad. Science, 98, 5981–5985 (2001).

KEYWORDS: Antibacterial, Chemical Agent, Biological Agent, Contamination, Neutralization, Decontamination

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CBD02-303 TITLE: Improved Filters for Chemical Warfare Agent Detectors

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: Develop and demonstrate a novel, inexpensive, filter that will pass chemical agents with high vapor pressure but still protects the detector sensor from the natural environment.

DESCRIPTION: Innovative and creative solutions are needed to address filtration problems in the detection of chemical warfare agents. The next generation of chemical warfare agent detectors must sense chemical agents of interest and operate in worldwide climatic environments. These environments include atmospheres that contain a very high particulate count, such as, dusty roads, helicopter landing zones, and desert terrain. Additionally, the filter must protect the interior of the detector from liquid water. These environments are subject to chemical agent attack and the next generation of man-mounted detectors has to function in these various environments. The 10 common chemical agents of interest include the chemical warfare agent VX. VX has a high vapor pressure and is viscous in nature.

The Joint Chemical Agent Detector (JCAD) and Lightweight Chemical Agent Detector (LCAD) are the future man-mounted personal detectors under development by the United States and United Kingdom, respectively. Both detectors will require filters to survive in the harsh worldwide environments. New, inlet air filtration solutions are required to pass the agents of interest while

excluding background particulate matter. The JCAD and LCAD are designed to require a minimum amount of operation and support activities. Any filter supplied for these detectors shall not increase their operating and support costs.

PHASE I: Using simulates, testing will be accomplished to prove the feasibility of the filtration method developed to effectively transport a VX nerve agent simulant across the media while excluding liquid water, sand, and dust as specified in MIL-STD-810. Specifically, the new method shall focus on the filtration media and any transport enhancements for Surface Acoustic Wave (SAW) and Ion Mobility Spectrometer (IMS) chemical agent detectors. Phase I will also address filter service life, cost per filter, and capability to scale-up the system proposed for mass production. In phase I, simulant data should demonstrate the feasibility of the improved filter.

PHASE II: Construct, assemble, and demonstrate a prototype filter. Demonstrate the capability to mass produce, or arrange for mass production of, the filters and integrate with the JCAD and LCAD detectors in a cost efficient manner. Government surety laboratory testing and additional simulant testing will be accomplished to verify the performance of the new filter when integrated with a detector and mass production processes.

PHASE III DUAL USE APPLICATIONS: Phase III military applications include fixed-wing aircraft, rotary-wing aircraft, tracked vehicles, wheeled vehicles, personnel, shipboard, and fixed-site applications. Phase III commercial applications include providing a novel filtration media to any air filtration device that must operation in adverse environments.

REFERENCES:
Web page -- http://www.sbccom.apgea.army.mil/products/jcad.htm

KEYWORDS: VX, Filter, Filtration, Chemical Warfare Agent Detector, Joint Chemical Agent Detector, Chemical Agent Detector, Surface Acoustic Wave, Ion Mobility Spectrometer

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CBD02-304 TITLE: Enhanced Biorecognition Reagent System

TECHNOLOGY AREAS: Chemical/Bio Defense, Biomedical

OBJECTIVE: Recent progress in the development of artificial biorecognition molecules (or aptamers) has shown that these aptamers in many cases bind as tightly and may be more robust than the antibodies they replace. 1, 2 The object of this project is to develop a system for producing biorecognition molecules which can be replicated rapidly at a single temperature between ~18 C (or ambient) and ~37C, which bind uniquely to either a desired nucleic acid or a desired protein, and which can be stored without losing efficacy in a dried form for months at a time with all other necessary chemicals other than the replicating enzyme. The new system should enhance the technology of biorecognition molecules in a way that will impact overall identification system performance by at least an order of magnitude.

DESCRIPTION: The new system will provide methods and examples of nucleic acid aptamers which can unambiguously detect specified pathogens as well as specified protein toxins in ten minutes or less. Aptamers will be constructed which can be shown to identify specified proteins in numbers and concentrations better than has been shown to be achievable with antibodies presently available. The aptamers will be self-replicatable, without thermal cycling by a factor of the order of 10E13 only in the presence of the target molecule and/or organism. The aptamers will be shown to survive in dirty environments and to be stable for several months in a ready-to-use state.

PHASE I: In Phase I, laboratory experiments with the developed reagent system must show that aptamers developed in this project recognize examples for at least two of the following, (1) a specific bacterial spore (2) a mammalian RNA virus, and (3) a specified protein, and indicate the presence of these entities at low levels and in conditions simulating field conditions. The aptamers must be shown to be propagated in the system under development by a factor adequate to be detected with a simple laboratory system in less than ten minutes without thermal cycling, at any single temperature in the range ~18 to 37 C. This requires use of an enzyme such as Qbeta replicase for RNA aptamers or development of an analogous enzyme with equal or better properties (robustness, fidelity, replication speed etc.) for replication of biorecognition molecules. The feasibility of the following must be shown. This replication must take place only in the case that the target molecule or organism is present. The target molecule must be identifiable with simple or no instrumentation, in concentrations lower than the best cases reported in refereed literature for antibody capture, or of the order of 200 target copies/ml.

PHASE II: The system must produce biorecognition molecules with a shelf life of at least several months in dried form and be reconstitutable simply by adding water. A kit will be fabricated using the technology developed in Phase I which consists of aptamers which can recognize several simulants and/or agents including two bacterial spores, two vegetative bacteria, a mammalian RNA virus, and two toxin simulants. The kit will contain these aptamers in dried form and also contain all chemicals necessary for the detection/identification process in dried form reconstitutable by adding water. The enzyme or enzymes necessary for the process will also be packaged in a storage form shown to survive conditions at least as severe as the storage form of any replication enzyme currently available for PCR identification systems. The kit must be usable with commercially available off the shelf instrumentation, no additional chemicals other than water, and must be supplied with a simple set of instructions for use and be usable with minimal additional instruction.

PHASE III DUAL USE APPLICATIONS: The aptamer systems produced will be utilizable in hospital pathology laboratories for very rapid identification of the presence of particular pathogens. They may be useful for monitoring food processing against the presence of common pathogens.

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3. Brian Zeiler, Abraham Grossman, and Burt V. Bronk, Proceedings of SPIE Vol. 4036 Chemical and Biological Sensing, Chair: Patrick J. Gardner, (April 2000)

KEYWORDS: Aptamers, Biorecognition Molecule, Pathogen Identification, Toxin Identification

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CBD02-305 TITLE: Residual Life Indicator for Advanced/Regenerable Air Filters

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: To develop a simple, robust technology that will accurately report the remaining capacity of adsorptive media in air filters in active service. For disposable media, this will permit disposal of individual units shortly before point of imminent failure, allowing maximum use of assets before disposal. For regenerable media, this technology will guide the schedule for reactivation.

DESCRIPTION: The candidate technology will create an observable or measurable response in proportion to the extent of saturation of the absorptive or adsorptive capacity along the sorption path of an existing or proposed static device for physical or chemical removal of CB agents and other volatile substances from air. A threshold response [for example, an oil-pressure indicator light] will qualify, but a graduated indicator [for example, differential pressure across a paint arrestor] would be preferred. Any property of the filter system may be used, and the process may include a challenge gas or other probe that neither significantly compromises the residual capacity of the filter nor dislodges contaminants previously adsorbed. A nonspecific detector is strongly preferred unless the specific material detected can be shown to accurately represent residual capacity to breakthrough of the least-strongly sorbed contaminant present. Cost, reliability, safety, and simplicity to use and maintain will be major factors in the selection process.

PHASE I: During phase I the contractor will conduct a critical experiment to demonstrate the technical feasibility of the physical/chemical principle to be used in the residual life indicator.

PHASE II: During phase II, contractor will assemble and evaluate the performance of an engineering model, which will be delivered to the government for possible further evaluation. The final evaluation will be conducted at >50 ft/min airflow and include a critical experimental test of the concept as implemented at that scale.

PHASE III DUAL USE APPLICATIONS: During phase III it is expected that contractor will pursue dual-use applications [for example, in odor or process air emission control, or personal safety equipment] to promote economy of scale, in addition to securing external funds to support completion of development of a shelf-ready product for DoD.

REFERENCES:
A example of an RLI specific for chlorine and mercury in the gas phase is discussed at
http://www.osha-slc.gov/OshDoc/Interp_data/I19890301.html.

KEYWORDS: Air Filters, Adsorption, Absorption, Capacity, Breakthrough, Residual Lifetime

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CBD02-306 TITLE: Establish a Non-aqueous Non-flammable and Non-corrosive Decontamination Process for Aircraft Cargo Interior

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: Develop a novel chem-bio decontamination process that can be used in aircraft cargo interiors without affecting the interior or its contents, and that can be applied in 15 minutes or less and not require reapplication.

DESCRIPTION: Innovative and creative solutions are needed to address the lack of a decontamination system that can decontaminate aircraft cargo interiors without affecting the aircraft, its equipment, the crew, or any cargo. Equipment and materials placed in cargo interiors span from delicate plastics to porous aluminum, all of which need to be decontaminated for continued worldwide use. This includes weapons, electronics and medical equipment. The host countries, where the aircraft may land, define the worldwide use of decontaminated materials differently. Therefore, all decontaminated materials from this process shall not off-gas chem-bio agents faster than a rate of 0.0018 mg-min-m3 (GD), 0.018 mg-min-m3 (HD) and 0.00061 mg-min-m3 (VX). Aircraft cargo interiors have numerous structural cavities that do not allow for standard aqueous-based decontamination processes. Also, the user community requires a decontamination system that can be applied in one single application and not require any additional support such as additional washing or vacuuming.

PHASE I: Phase I will produce a novel decontamination process to be used in aircraft cargo interiors. The proposed process will be tested to prove the efficacy and the results documented in the final report.

PHASE II: Phase II will develop a system prototype, fully tested, to demonstrate that the application can be accomplished in 30 minutes or less and that reapplication is unnecessary.

PHASE III DUAL USE APPLICATIONS: Phase III military applications include expansion of application to decontaminate sensitive equipment for the joint service community. Sensitive equipment involves equipment such as aircraft pitot tubes, optics, aircraft electronics ground equipment electro-mechanics and electronics, and composite materials. Commercial uses include decontamination of chemical spills during transport of hazardous materials via aircraft or commercial vehicles. More importantly, this solution can be used to decontaminate aircraft from other countries plagued with outbreaks of Foot and Mouth Disease or any other contagious disease where contamination of various types of surface materials is problematic.

REFERENCES:
"Large Aircraft Interior Decontamination Foreign Comparative Test Final Report December 2000", 311 HSW/YACN

KEYWORDS: Decontamination, Treatment, Toxic Industrial Material, Toxic Industrial Chemical, Chemical, Chemical Warfare Agent

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SOCOM CBD SBIR TOPICS

CBD02-400 TITLE: Hand-held, Standoff Chemical-Biological Hazard Detector

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: To develop a hand-held (flashlight sized) standoff detector capable of detecting chemical agent vapors and aerosols, chemical precursor vapors, and other potentially hazardous materials. An objective would be for detection of surface hazards (e.g. liquids). The system must identify the hazard by class (e.g. nerve agent, blood agent, choking agent, incapacitating agent, etc.), and be capable of distinguishing hazards in the presence of common interferents. An additional objective would be for the detector to provide specific identification of the hazard. The system should provide standoff detection from the detector out to a distance of ~150 feet, providing an audible or visual alarm. The detector should use standard batteries (objective). The power source should last a minimum of 12 hours, however, operations may not need to be continuous during this period.

DESCRIPTION: During direct action or room clearing operations in urban environments, special operations forces (SOF) must rely on point detectors and monitors for warning of CB-related hazards. These do not detect rapidly enough to provide sufficient warning for the individual carrying it to don protective gear. SOF operators are forced to either don protective gear prior to an operation, or risk potential exposure to hazards, which may incapacitate or kill. A hand-held standoff detector would allow SOF sufficient warning to don protective gear or avoid entry into hazardous areas.

PHASE I: Demonstrate viability of the recommended approach through bench-top prototype or existing proven technology. Develop an overall system design for a ruggedized hand-held, standoff detection system for identifying CB hazards.

PHASE II: Develop and demonstrate a ruggedized prototype hand-held, standoff detector in SOF mission scenarios. Verify hazard identification performance through simulated agent tests.

PHASE III DUAL USE APPLICATIONS: The technology could be adapted to a broad range of military and civilian hazard detection applications, such as a first responder detector for fire departments.

REFERENCES:
"A Critical Review of Sources of Spectral Data for Military Significant Compounds", CBIAC, Dec 1995, ISBN #1-888727-06-3

KEYWORDS: Chemical-Biological (CB) Detection, Standoff Detection, CB Agents, Precursors, Hazards

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